Individual differences in perceptual adaptation to unfamiliar speech sound categories

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Research Questions

1. Do listeners up-weight a secondary cue (i.e. duration) when a primary cue (i.e. spectral differences) to vowel category is not informative?

2. Are individual differences in phoneme categorization gradiency linked to secondary cue use and cognitive abilities?

3. Do individual differences in gradiency and cognitive abilities predict patterns of perceptual adaptation?

Background

Can listeners adapt to unfamiliar speech by using secondary acoustic dimensions? If so, what makes some listeners better adaptors?

Perceptual adaptation in acoustic-phonetic perception

- Listeners may adapt to unfamiliar speech categories by increasing reliance on a secondary cue when confronted with an uninformative primary cue (e.g. non-native English vowels) [cf. 1].

Categorization gradiency in speech perception

- Listeners who have more gradient categorization patterns are more sensitive to secondary acoustic cues [2, 3].

Cognitive abilities in speech perception

- Cognitive abilities (e.g. inhibitory control, working memory) play a role in adaptation to unfamiliar speech [4, 5].
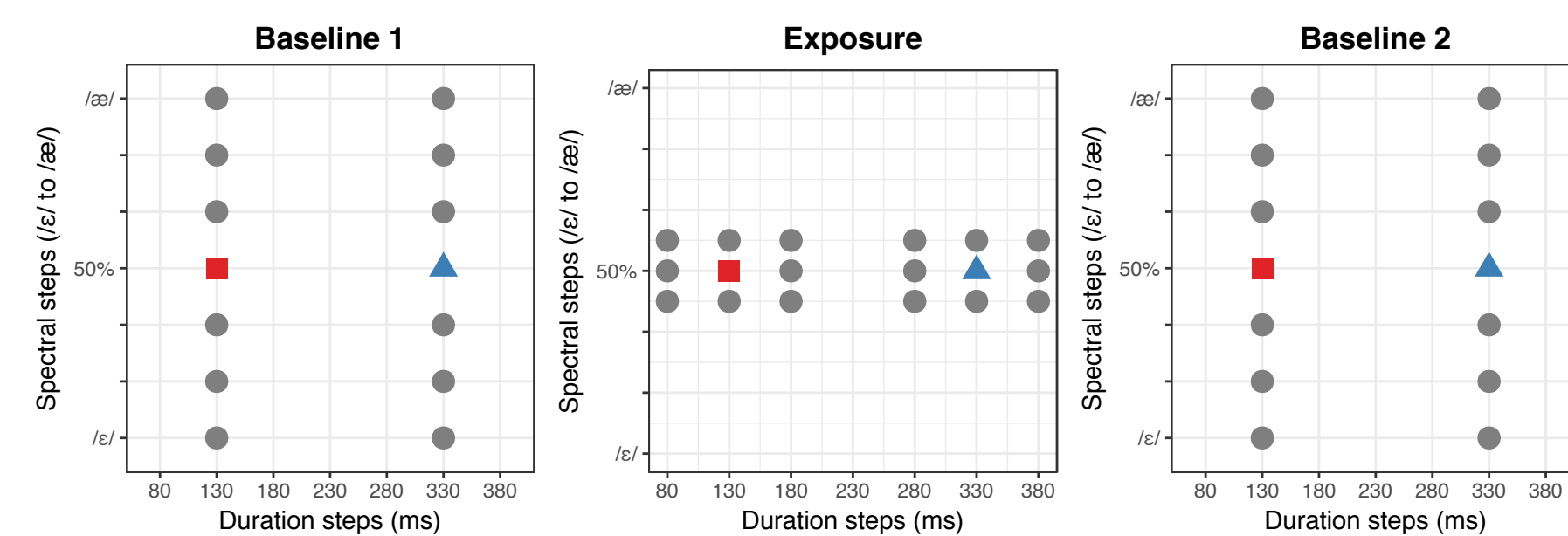
Methods

Participants

- 36 monolingual speakers of Canadian English

Perceptual adaptation

- **Baseline**: a subset of stimuli from the VAS task

- **Exposure**: 6 tokens at the most ambiguous spectral step and adjacent ambiguous tokens
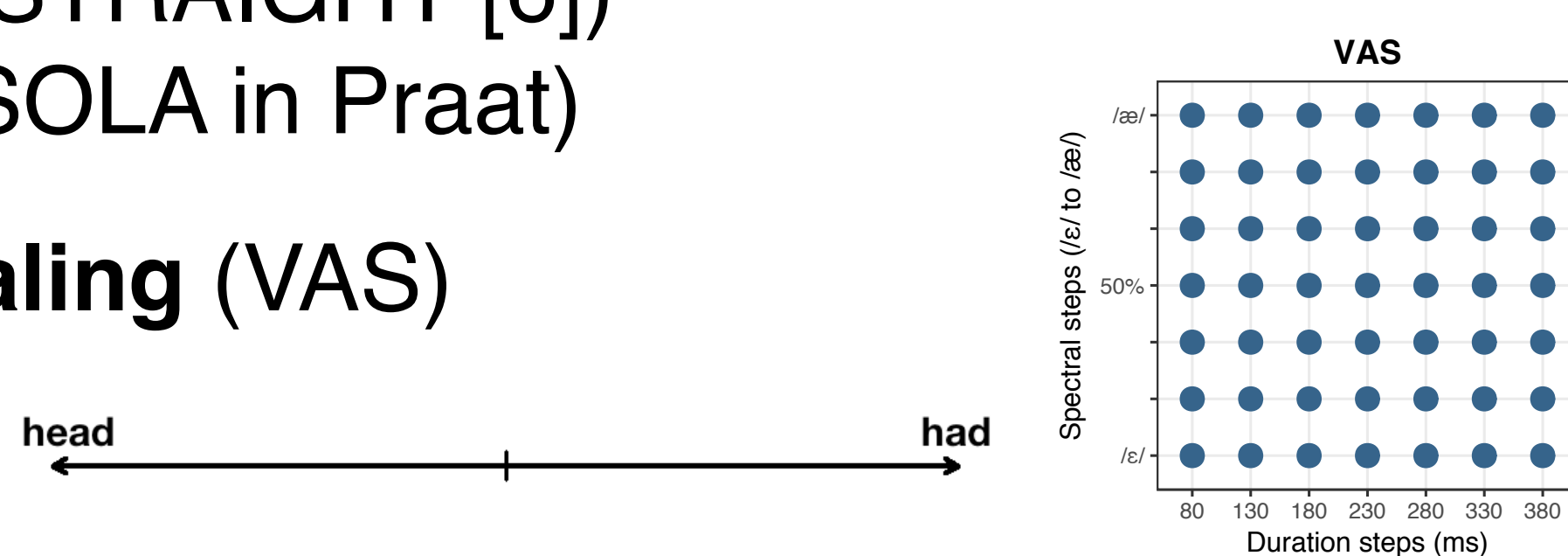
- Test stimuli (■ & ▲)

- **2AFC**: *head* or *had*

Phoneme categorization gradiency

- 7 spectral (TANDEM-STRAIGHT [6]) x 7 duration steps (PSOLA in Praat)

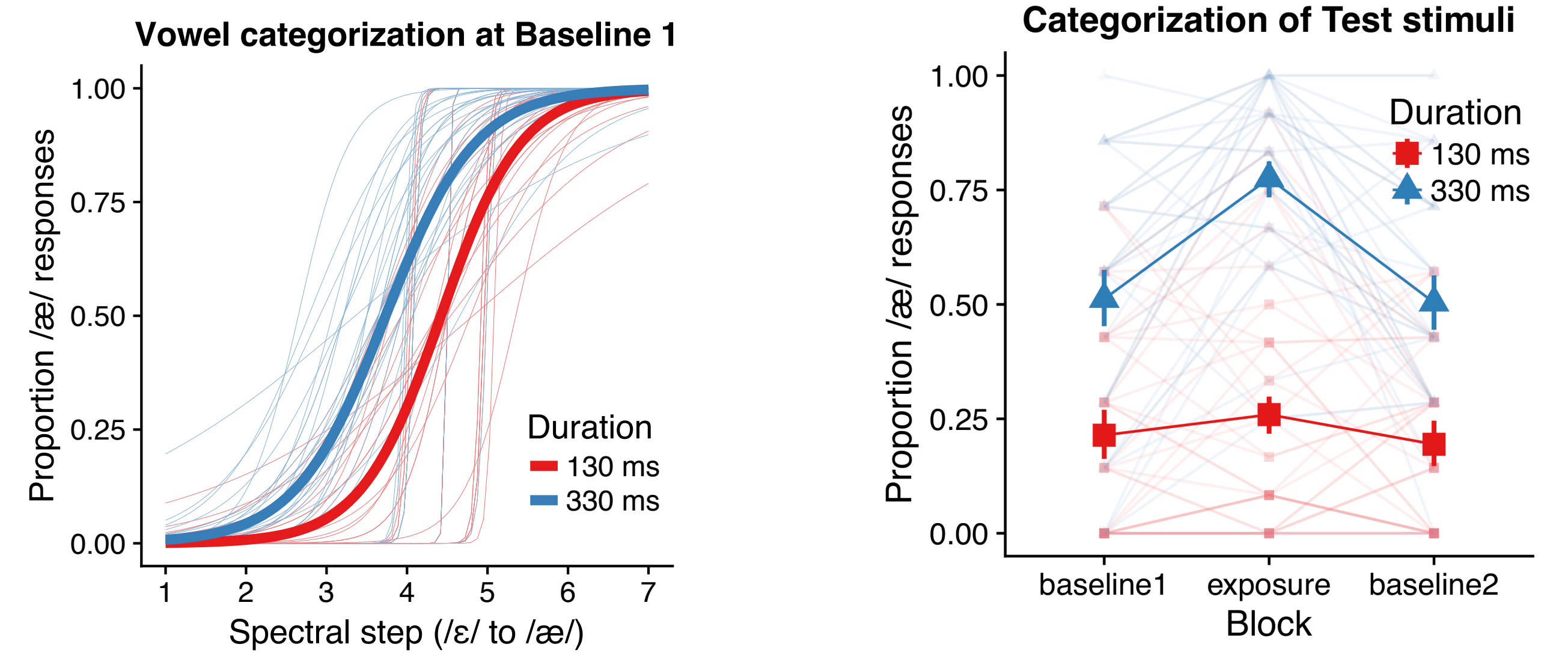- **Visual Analogue Scaling** (VAS)

Cognitive abilities

- **Inhibitory control** (Stroop), **Working memory** (Corsi), **Cognitive flexibility** (Berg Card Sorting), **Sustained attention** (Continuous Performance) [7]

Results

RQ1: Listeners flexibly adapted to unfamiliar vowels by up-weighting reliance on a secondary cue when a primary cue is not informative.


Primary use of spectral differences at Baseline

Increased reliance on duration when spectral differences are not informative at Exposure

RQ2: Individuals varied widely in categorization gradiency and this variability was linked to their use of a secondary cue and working memory capacity.
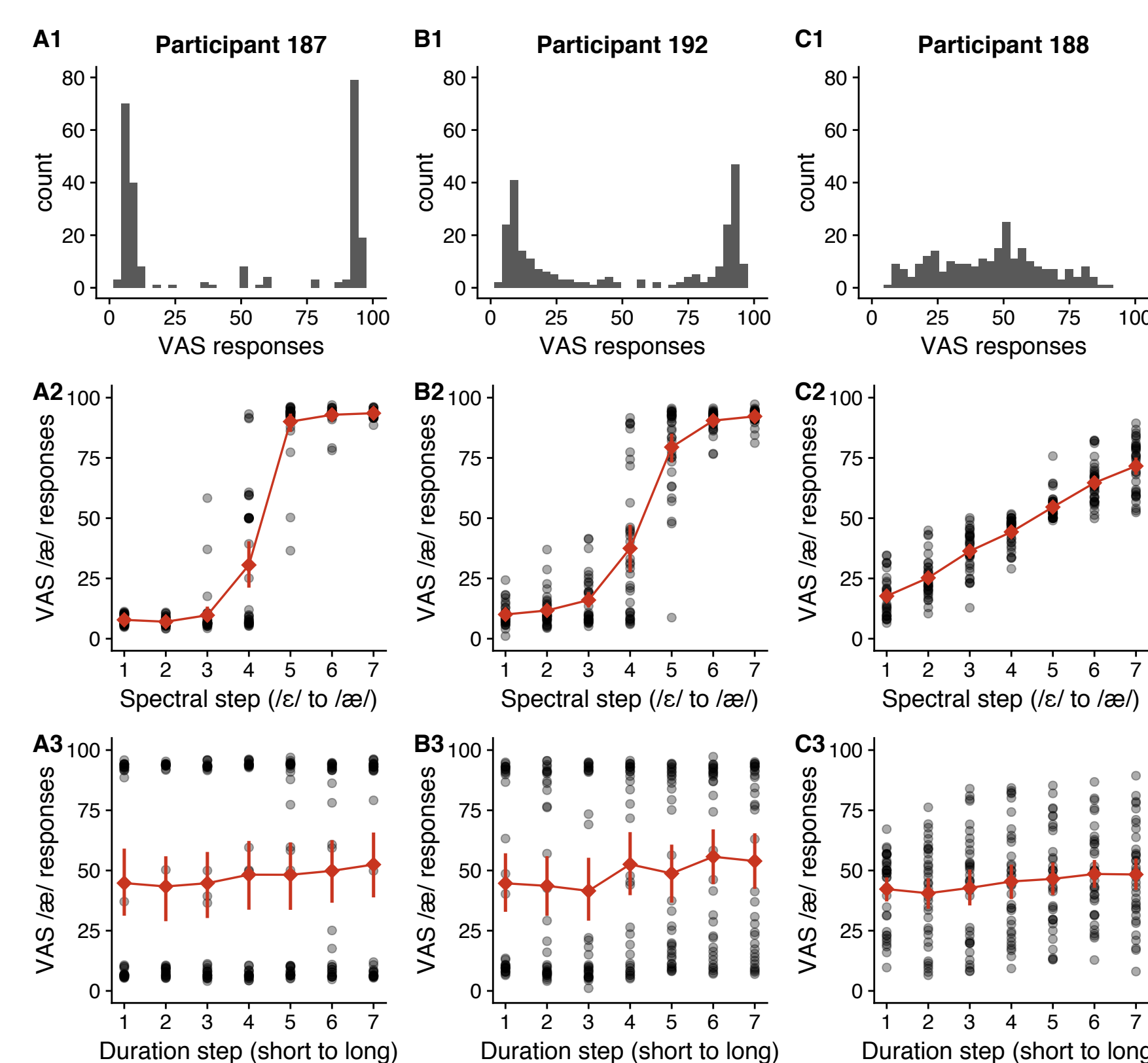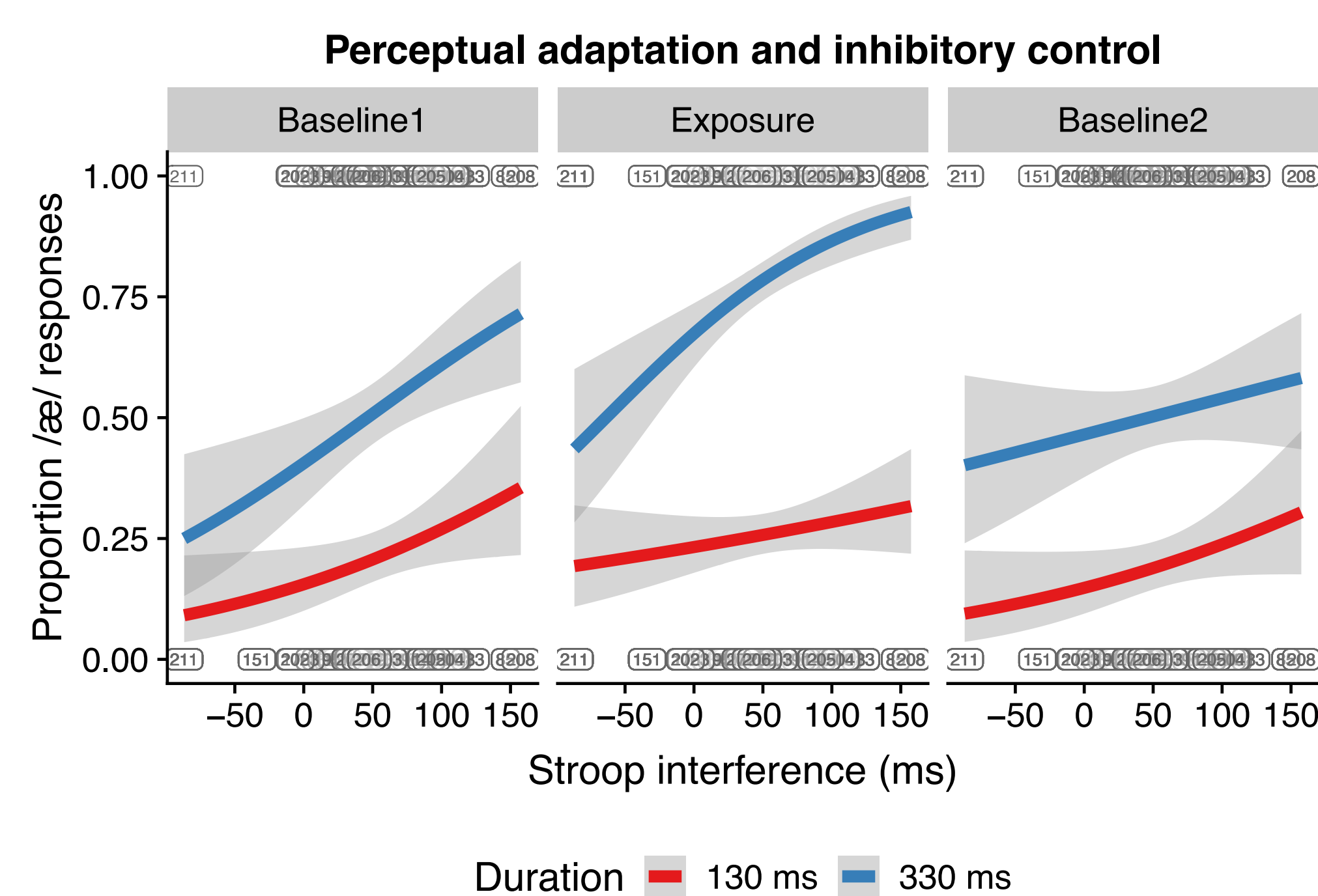

Considerable **individual differences** in gradiency in phoneme categorization
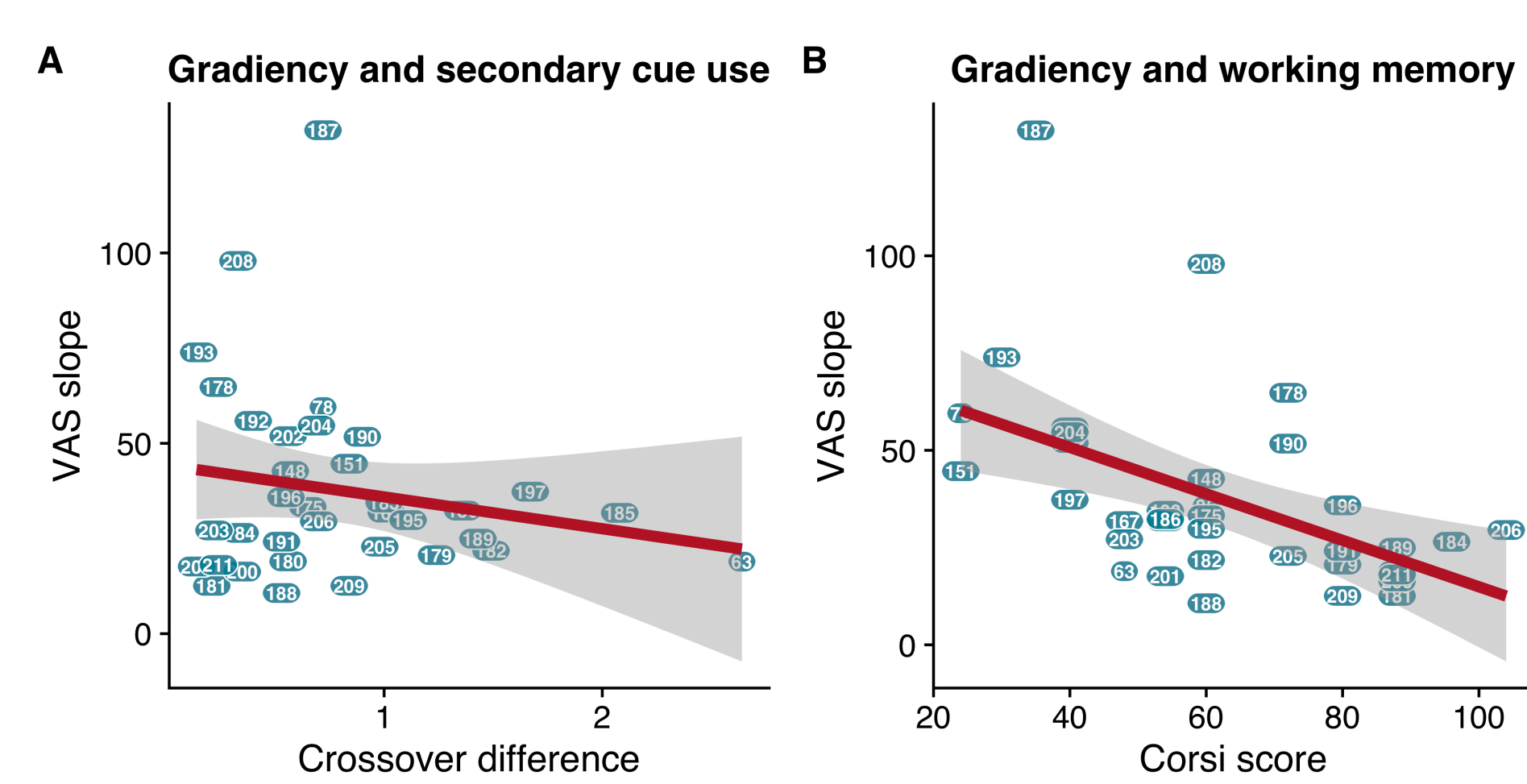
The more **gradient**, the more **secondary cue** use & better **working memory** capacity.

RQ3: Individual differences in inhibitory control was linked to the amount of adaptation.

Individuals with **lower inhibitory control** showed **more adaptation** at Exposure.

References: [1] Idemaru, K., & Holt, L. L. (2011). Word recognition reflects dimension-based statistical learning. *Journal of Experimental Psychology: Human Perception and Performance, 37*(6), 1939–1956. [2] Kapnoula, E. C., Winn, M. B., Kong, E. J., Edwards, J. R., & McMurray, B. (2017). Evaluating the sources and functions of gradiency in phoneme categorization: An individual differences approach. *Journal of Experimental Psychology: Human Perception and Performance, 43*(9), 1594–1611. [3] Kong, E. J., & Edwards, J. R. (2016). Individual differences in categorical perception of speech: Cue weighting and executive function. *Journal of Phonetics, 59*, 40–57. [4] Banks, B., Gowen, E., Munro, K. J., & Adank, P. M. (2015). Cognitive predictors of perceptual adaptation to accented speech. *Journal of the Acoustical Society of America, 137*(4), 2015–2024. [5] Janse, E., & Adank, P. M. (2012). Predicting foreign-accent adaptation in older adults. *Quarterly Journal of Experimental Psychology, 65*(8), 1563–1585. [6] Kawahara, H., Takahashi, T., Morise, M., & Banno, H. (2009). Development of exploratory research tools based on TANDEM-STRAIGHT. Proceedings of Asia-Pacific Signal and Information Processing Association, 2009 Annual Summit and Conference. pp. 111–120. [7] Mueller, S. T., & Piper, B. J. (2014). The psychology experiment building language (PEBL) and PEBL test battery. *Journal of Neuroscience Methods, 222*, 250–259.